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Interactions Between Astronomical Traditions of India and other Civilizations

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Introduction: The necessity for the conceptualization, evolution, application and systematic codification of astronomical knowledge was a pre-requisite for any civilization in its advanced stage. The essentiality of the astronomical knowledge is linked with sea voyages, international trade, astrology, geography, cosmology. cosmogony, mathematics, philosophy etc., with man's interest in nature, world and Universe. The requirement of such varied subjects in a society proves man's status and his interplay with nature, world and Universe. Such interplay is connected with his conceptualization, systematization and practice of religion, and connected rites, rituals and ceremonies. Therefore, the interactions between astronomical traditions depend upon the indispensability and requisiteness of such knowledge on the same lines. The communication involves transmission and reception of such required traditions and their adoption and adaptation thereof. To what extent such astronomical traditions have been consistent and continuous with the existing civilizations is the important factor to assess the quality and quantity of such interactions taken place.

What Were / Are Indian Astronomical Traditions?: The Indian astronomical traditions have clear roots in Vedas (c.3500-1500 BCE) as they contain numerous references about the asterism, planetary position, Universe and their phenomena. Whether such Vedic roots could be related to Indus Valley or Saraswati or Kumari or otherwise, their astronomical origins clearly prove Indian-ness. Not only the archaeological, epigraphical, numismatic, historical and other evidences, but also the existing and continuing traditions vouchsafe the fact. The oldest astronomical text available is Vedanga Jyotisa of Lagadha datable to c.1400 BCE[1]. The same traditions are followed obviously with variants at different parts of India because of huge time lag. The astronomical traditions always live even today in India in performing various rites, conducting periodical rituals and celebration of different festivals to commemorate and coincide with astronomically significant events like eclipses of Sun and Moon, Conjunction of planets, movement of Sun from north to south and vice versa and so on. Such traditions might have been prevalent in other civilizations, but they were dead, as they themselves no longer exist. But, only in India such traditions and tradition of tradition continue.

What Are the Factors of Interactions?: Interactions necessitate the utility, usage and profitability of knowledge. The immediate acceptability and applicability prove the universality of the application of knowledge. And moreover, how transmission took place should be noted and recorded carefully to identify the transmitter and receiver, because the transmitter could not transmit information and receivers to receive it just like that. Any subject can be knowledge based, but universality of it could be decided only

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through its application. However, the astronomical interaction of the traditions of other civilizations with India had been different. Therefore, if knowledge of one particular system was transferred from one tradition to another tradition, its necessity, utility and applicability expose the fact. That too, when a tradition is rich capable of meeting all exigencies satisfying the needs of the people, even if anything is borrowed, it may not be acceptable or accepted by them.

Indian Trade with the Ancient World from 3600 BCE to 100 CE: The Indian trade contacts with the ancient world have been well established. The ability of Indian traders, sailors, mariners and others to travel distant lands with merchandise, their establishment of colonies in those countries have been proved by their own accounts and supported by archaeological evidences.

The Chinese connection with India has been multifarious since time immemorial, as the two civilizations have been in existence and continuing. The pre-Buddhist, Buddhist and post Buddhist contacts are significant. L. Austine Waddle describes about the Chinese marital relationships with Nepal and India through Tibetan lamas and also with Tibet[2]. The trade through silk route is too well known to be repeated here,

Indus Valley, Seals have been found in Middle Eastern and African countries. According to S.R. Rao[3], the Harappans (3500-2000 BCE) carried on brisk overseas trade with Bahrain, Sumer and African countries. The establishment of merchant colonies in overseas territories is attested by the occurrence of Indus seals and weights in Oman, Bahrain, Failaka and at Ur besides Kish, Brak and Arppachiya in Mesopotamia (Iraq) and at Hissar and Susa in Elam. Therefore, their astronomical knowledge has to be recognized and appreciated, as it was definitely used by them for their activities.

There were distinct sea routes running from India to Hadramant and Adana, and linking East Africa with the wonderland on the Ganges. The Egyptian Pharaohs already knew and used these connections. True, knowledge of the monsoons, those winds blow in summer from Africa to India and in late autumn reverse their direction and blow from India to Africa, is attested only for later ages. No doubt both sides in the India-Africa trade did all they could to keep their knowledge secret[4].

For many millennia, incense was accompanied along this road (from India to Egypt though Arabia) by the precious things and luxury commodities of India and Far East. For these parts of the earth also derived their supplies of incense from Hadramat (in Southern Arabia). With the monsoons, Indian traders arrived from the port of Bargaza, the modern Broach at the mouth of the River Narmada on the West Coast of India. They purchased incense with teak from Further India, which was built into the palaces of the rich merchants of the Yemen, with sweet-smelling nards from the Ganges and aromatic malabathrum (cinnamon leaves), and silk from Cin (China), tortoise-shell from Malacca, Indigo, pepper, diamonds, emeralds, sapphires, and lapis lazull from India[5].

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In 1493 BCE, Hatshepsut dispatched five great galleys of thirty rowers to Punt from Kossier. The things brought by the Punt's expedition contained costly gems, which were nothing but Indian emeralds and turquoises, lapis lazuli and sapphires. These items were reaching Egypt via the land route from Hadramat and Aden. Though, where exactly Punt was there, is not known, for a long time it was sought in India. The fact that many islands bear the Sanskrit names - Socotra derived from Dvipa Sukhadhara- the island Abode of Bliss, the port of Sofala from Supara-Land of Beautiful Shore etc proves that it is quite possible that knowledge of the monsoons might have been made possible for the sailors to sail to India and back.

As evident from the Greek accounts, the Greek's fascination was for India was more than any other country. According to them, Hecataeus[6] circa 500 BCE for the first time mentioned Hindus as Indol, because as a Hither Asian Ionian, he could not pronounce an "h". Strabo remarked ironically had Homer known India, he would have made his heroes to sail to India.

Pausanias' earlier colleague, the Roman chronicler Pomponius Mela, who lived during the time of Caesar, provides the following account[7]:

> ".....***Besides the natural philosophers and Homner, Comelius Nepos, a more recent and credible historian, also asserts that the earth is surrounded by sea. He names Q. Metellus Celer as his authority for this. The latter reports the following: When he was proconsul in Gaul (62 BCE) several Indians were presented to him as a gift by the king of the Suevans. On Inquiring where these men had come from, he was told that they came from Indian seas, having been carried by high winds across the Intervening seas and finally cast up on the shores of Germany....."***

The theory that India colonized Egypt was propounded by Phiodtrastus and Eusebius in ancient times and by Charles Francious Dupius, Sir William Jones, Colonel Wilford[8], Dr. Robert Taylor, Edward Pococke[9] and others in modern times. The American orientalist. Alexander Del Mar maintains[10]:

> "**There are evidences that the first adventurers from the orient came to Egypt by sea from Ceylon by way of Arabia and Abyssinia or Ethiopia. Both Diodorus and Arrian regarded the Arabians of the coasts as Indians. The early history of Ethiopian contains many reminiscences of India. Egyptian epigraphy points to the land of Puant as the earliest landing place of the gold seekers, "punt being an India word for gold. The land of Punt was on the Red Sea near Bab-el-Mandeb. Following the Cingalese came the gold-seekers, from Malbar and Gulf of Cutch and still others from Orissa and the Bay of Bengal, the latter with Tibetan myths and place names; in short all of the coast tribes of Bharatvarsa**"

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Thus, when Indian contacts with the west had been time immemorial, when there was no Greek, Roman and other civilizations, from whom Indian are allegedly derived their astronomical knowledge as proposed and contended by the western scholars.

The Interactions Between Indians and Chinese: China and India have been the most ancient civilizations continuing since time immemorial and they have contacts. Even before the introduction of Buddhism into China, the contacts were discerned because of the spread of medicinal and philosophical methods. The oldest medical book of China belongs to 2578 BCE and it has Indian influence[11]. The Prakriti - Purusha concept is revealed in Yang and Ching of Laotse (604 BCE).

Though Chinese and Hindus were using the 27 asterism, the Hindu asterism system was transmitted to the Chinese and not the other way[12]. The concept of Hindu zero was introduced into China in the middle of 19th century[13].

H. P. Blavatsky points out the following similarities between Indian and Chinese systems of astronomy. The Chinese divide their zodiac into twenty-four parts and their year into twenty-four fortnights, but such computation did not, not does it, prevent them from having as astronomical year just like us. They also have a period of 60 days-the Southern Indian Rudu-to this day in some provinces. They divide their year into two parts from one equinox to other[14]. This is similar to Uttarayana and Dakhsinayana. The Chinese revere Tien (or sky, Ouranos), and name him as their first astronomer. For Indians, the first teacher of astronomy (Jyotisha) was Jyotis, is one of the seven Prajapatis (Matyapurana). Dr. Schlegal[15] assigns to the Chinese astronomical sphere 3-Can antiquity of 18,000 years. The planetary conjunctions were considered important in China. The rare conjunction of Saturn, Jupiter and Mars has its significance and importance on account of its certain great results in India, China as much as it has in Europe, for respective mystics of these countries[16].

The Interactions Between Indians and Assyrians / Babylonians / Sumerians: Indian has always been accused of deriving zodiac from the Assyrians / Babylonians/ Sumerians, besides Greeks. However, the fact that India too had contacts with such civilizations is not mentioned. To cite an example, in a treaty between Mittannians and Hittites, the gods Mitrasil, Arunasil, Indar and Nasattyana have been mentioned and they are nothing but Mithra, Varuna, Indra and Nassatyas of Vedas Invoked side by side with Teshup and Hopa by the ancient Iraqis[17]. Therefore, it is not known why the people of the civilization should invoke the Gods of Hindu civilization. If both the civilizations were invoking the same Gods, it is evident that they derived their knowledge from a common source.

Sebokht (662 CE), a Syrian scholar lived in the convent of Kennechre on the Euphrastes, in the time of Patriarch Athanasius Gamenale (died in 631) and his successor John, offended by the Greek arrogance, he retorted as follows[18]:

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> "I will omit all discussion of the science of Hindus, a people not the same as the Syrians, their subtle discoveries in the science of astronomy, discoveries that are more Ingenious than those of the Greeks and the Babylonians, their computing that surpass description. I wish only to say that computation is done by means of signs. If those who believe because they speak Greek, they have reached the limits of science should know these things, they would be conceived that there also others who know something"

However, scholars opine that Surya Siddhanta was introduced into India from Babylon, Zodiac and its signs were derived from the Sumerians and so on.

The Interactions between Indians and Greeks: The Greek accounts themselves clearly record their quest for Indian knowledge, however, the astronomical interactions of them have been controversialized because of the pro-Greek and western bias. Though, the sojourn of Pythagoras to India has been well established, the western scholars have always decided to suppress it or sidetrack with Indirect influences. But, he derived Sankya system of representation of numerals to philosophical concepts along with the metempsychosis only from India. Appolonius of Tyana modelled his own life on Pythagoras and visited not only Egypt and Babylon, but also India. Philostratus gives the account of his visit to India.

The Alexander's invasion (327-326 BCE) of India is taken as the sheet anchor for the Indian chronology and as well as the transmission of knowledge from Greece to India. But, the sojourn of Greek scholars to India and the explicit influence noted in their work tell different story. Similarly, the alleged influence of Greeks on Aryabhatiyam for using the alphabets for numbers, the value of pi etc., is unfounded. About the origin zodiac and usage rival claims are made. Initially credit was given to India and then shifted to Babylon from Greece by the western scholars.

Varahamihira was perhaps the first astronomer to adopt and adapt Greek system and till such time, the India's contribution to Greece may not be denied. But unfortunately, such attitude of acknowledgement of Indian sources by other scholars is not found in the works of Greeks, Romans etc. Even, references are found, the western scholars deliberately suppress and do not mention in their works with blatant bias against India.

The Greek accounts record that Alexander forcefully carried many Indians including some sages after his invasion of North West of India. Therefore, it is quite possible that they were experts and scholars in the respective fields. However, it may be noted that no Indian King has ever brought others to India,

The Interactions Between Indians and Arabs: The interactions of Indians and Arabs in the astronomical and mathematical contexts have been well documented. Following the spurt in Arabic literature with the rise of Islam, Indian works were translated into Arabic between 750-850 CE through Persian, Many books, charts, implements, and other Instruments were taken away to their respective countries for further study. The

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astronomical and mathematical works were adapted and adopted straight away and modified also to suit their needs. The Indian numbers were mentioned as Sind-Hind and the Siddhanta works used practically. Al-Beruni is one of the best examples for the transfer of Indian, astronomical knowledge to Arab countries, His work on the Chronology of the ancient nations meticulously had dealt with the different astronomical methods used. As most of the Indian, concepts, terminology and examples were Arabized, they appeared as if they were the Inventors and thus, the westerners called Indian numerals Arabic and so on.

The European Quest for Indian Knowledge: The European quest for Indian knowledge is multifarious. Starting with the quest for knowledge, their interests turned to commercial and later political with colonial exploitation. The European astronomers were struggling to find out and fix longitudes for the planets (the so-called longitudinal problem), devise a correct calendar and navigatory methods. When they learned that Indians were using the Prime Meridian (Ujjain / Avanti) for planetary position, calendar with Kall era with accurate time measurement, many astronomical and mathematical books with charts and tables, they wanted to acquire them at any cost. Moreover, their seafaring activities necessitated its immediate requirement. As the Arabs monopolized the land route, they had to find out the sea route to India. The monsoon and tidal usage of voyages was kept secret by the traditional mariners like Indians, Chinese, Arabs and others. Unlike, Indians, the Arabs wanted to monopolize the sea route with the threat of piracy. For accurate technique of navigation the Spanish government (1567 & 1598), the Dutch government (1632), the French government (1670), and the British govemment (1711) offered prizes.

Many famous scientists, mathematicians and others involved in the study of astronomy. chronology and connected subjects of India. For them, many astronomical works, tables, charts and other documents were collected from India and sent to them. Sir Isaac Newton discussed about the chronology of the ancient kingdoms[19]. Joseph Priestley compared the Institutions of Moses with those of Hindus[20]. John Playfair discussed about the Indian astronomical tables[21]. Jean Sylvian Bailey[22] and Giovanni Cassini published a book on Hindu Astronomy explaining the calculations and involved topics. Euler wrote on Hindu calendar. Jean Baptist Blot discussed about Hindu and Chinese asterisms. The influence of Hindu scriptures on Oppenheimer, De Broglie and others has been pointed out from their biographies themselves.

How the Manuscripts, Charts, Tables Reached Europe?: Catalogues officially published by the different European Universities – Paris, London, Oxford, British Museum, India Office, Berlin, Leipzig, Vatican library give the list of thousands of manuscripts preserved there. Unofficially, the scientists, researchers and scholars might have been in possession of many manuscripts, as is evident from their quoting in their works. That hundreds of German scholars were writing about and translating Indian works prove that they were in possession of such manuscripts, documents, charts and tables[23]. Robert W. Wink's note is also very relevant this context[24]:

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"The most impressive orientalist explorations were collaborative, unofficial and voluntary. Among these, none matched the enormous privately funded venture by Colonel Colin Mackenzie. His teams of Maratha Brahman scholars begged, bought or borrowed, and copied, from village heads, virtually every manuscript of value they could finally acquired. Collections so acquired, reflecting the civilization of South India, manuscripts in every language, became a lasting legacy – something still being explored. Privately financed efforts by dedicated and enthusiastic gentry, European and Indian alike, multiplied. Collections of manuscripts in every part of India, such as those of C. P. Brown (Madras) and Walter Elliot (London), Saraswat Mahal (Thanjavur), Saiyidia Library (Madras and Hyderabad), Khuda Baksh (Patna), and Salar Jung (Hyderabad) and Iniyat Jung (Aligarh), proliferated. Work done by the Asiatic Society of Bengal and by the Madras Literary Society, reflected in their Journals, became a fashion. Neither the scorn of James Mill, not of Edward Said, has diminished the appeal of this tradition in India".

That many scholars like Max Mueller were translating Sanskrit works into English even without seeing India proves that they were having thousands of manuscripts. However, the important charts, tables and documents taken away by the missionaries and others in the context is tabulated for ready reference. The list is only illustrative and not exhaustive.

Sl. No	**Indian manuscripts taken away by**	**From where taken**	**When taken / period**	**Place, where they are available**	**The source / reference, which records**
1	Roman Catholic missionaries	Different parts of India	15th to 19th centuries (thousands of palm-leaves, charts, tables etc.)	Vatican, Italy.	P. Palino A.. S. Bartholomaeo, ***Historico-Criticum Codicum Indicorum***, Rome, 1792
2	M. la Loubere	Siam (belongs to 638 CE)	1687 (two sets of tables)	France	John Playfair, ***Some Remarks on the Astronomy of Brahmins***, Edinburgh, 1789, p.4.
3	French Christian missionaries	India	Sent two sets of tables to Paris	Paris	Ibid, p.5. Gentil studied these tables later. Published in the Memoirs of the Academy of Sciences in 1772.

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4	M. Le Gentil	India	1769	Paris	Gentil was there in India to observe the transit of Venus in 1769.
5	Fr. Du Champ, a Christian missionary	Chrisnabouram , a town in Carnatic (tables datable to 1491 CE)	1750 (15 tables)	The Academy of Sciences, Paris	Ibid, p.14. Studied by M. De L'Isle.
6	Fr. Du Champ, a Christian missionary	Chrisnabouram , a town in Carnatic	1751-53?	The Academy of Sciences, Paris	He brought other materials with precepts and examples from the Brahmins of Chrinabouram, and which were later translated into French.
7	Fr.Patouillet	Narasapour	Of the same period as that of Chrisnabouram c.1750	The Academy of Sciences, Paris	Received by M. De L'Isle, which contain rule to determine the length of the day.
8	Al-biruni	North Indian cities.	11th century	Ghazni	E.S. Kennedy, ***A Commentary Upon Biruni's Kitab Tahid al Amakin, An 11th century Treatise on Mathematical Geography***, American University of Beirut, Beirut, 1973.
9	Robert de Nobili (1577-1656)	Madurai, Sri Rangam, Trichy, Tanjore, Salem and other cities.	17th century	Vatican, Rome, The Library of King of France.	V. Cronin, ***A Pearl to India***, pp.176-182; J. L. Mirana, ***The Introduction of Christianity into the Heart of India***, pp.22f. J. Hough, ***A History of Christianity in India***, Vol.II, pp.237-240 and Appendix C. J. Schmidlin, ***Catholic Mission History***, USA, 1933, p.302
10	Mattteo Ricci	Goa. Collected manuscripts were sent	16th and 17th centuries..	Vatican, Rome	

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		through him.			
11	American Missionaries	Many medical, mathematical, astronomical, chemical Mss.		Harvard, Osler, McGill Universities, USA.	Introduction to Science during 14th century.
12	Colonel Colin Mackenzie	-do-		Ships loaded with privately acquired manuscripts were sent to London, but later reportedly returned to Madras.	Robert W. Winks (Ed)., ***Historiography***, Vol.V of the Oxford History of the British Empire, 1999, USA, p.197.
13	Walter Elliot	-do-		London	-do-
14	C. P. Brown	-do-		Madras	-do-
15	H.T.Colebrooke	-do-	18th century	India office, London	A. A. Macdonell, ***India's Past***, Motilal, 1956, p.247.

How Transmission or Exchange Possible? The writers making analytical study of analogies existing between different people or particular two people groups generally advance one of the following theories to explain the phenomenon:

1. The Theory of Borrowal.
2. The Theory of Common Origin.
3. The Theory of Independent Parallelism.

The Theory of borrowal: Originally, a certain invention. Idea, implement, cadget, usage of anything was found by a group of people and it is found among others, it is evident that the latter must have borrowed from the former. Here, the precondition is that proven originator must be there, so that others can borrow.

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The Theory of Common Origin: That such ideas/ inventions etc., might have been originated from a common source, now existing among different peoples or nations by spreading from it.

The Theory of Independent Parallelism: As man is subjected to similar conditions of surroundings and environments, with his struggle against nature might have arrived at the same results, invented / discovered same things or devised implements / gadgets without any external influence, because necessity is the mother of invention.

Based on Histomap prepared by W.F. Spark, the different civilizations existed and their periods are given as follows:

Sl.No	Name of the Civilization	Period of existence	No. of years
1	Sumeria	2150-2000 BCE	150
2	Babylonia	2000-400 BCE	1600
3	Iran	2000-250 BCE	1850
4	Egypt (Mishra)	2000-150 BCE	1850
5	Assyria	1450-150 BCE	950
6	Greece (Yunan)	800 BCE-150 CE	1300
7	Rome	800 BCE-500 CE	1300
8	Hun (Central Asia)	2000 BCE-700 CE	2700

According to him, the only two ancient civilizations, which have been continuing even today, are Chinese and Indian without any break.

Therefore, if go by the theories, other civilizations must have borrowed from these two civilizations and not the other way. The Aryabhata group working in the University of Exeter, UK has been documenting the transmission of the Calculus from Kerala to Europe. Taking clue from legal parlance, it tests the hypothesis on the grounds of motivation, opportunity, circumstantial evidence and documentary evidences.

Conclusion: The word Interaction connotes the requirement of two groups for act and react in the context of astronomical tradition. As the tradition of India has much greater antiquity than that of all other civilizations, as for as India is concerned, India cannot be characterized as a simple borrower. If any aspect is taken for study, it has to be analyzed carefully with all connected factors, as Indian astronomical tradition has been unique in the sense that it is percolated even to the common men, peasants, villagers and others. In intellectual context, as pointed out in the case of Varahamihira, interactions might be fruitful. But, later-day scholars should not cast aspersion on India with a sole aim to misinterpret the facts, misrepresent the data and misapplication of research methodology. As the study involves multi-disciplinary one, scholars of astronomy, mathematics, Sanskrit, history and others should sit together and bring out the facts in right perspective.

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